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# MULTIMEDIA UNIVERSITY

## FINAL EXAMINATION

TRIMESTER 1, 2017/2018

**EEL4106 – HIGH VOLTAGE ENGINEERING**  
( LE )

23 OCTOBER 2017  
2.30 P.M. – 4:30 P.M.  
(2 Hours)

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### INSTRUCTIONS TO STUDENT

1. This question paper consists of 3 pages including the cover page with 4 Questions only.
2. Answer **ALL** questions. The distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

**Question 1**

- (a) List down THREE main types of voltages being generated at high levels for testing purposes. For each type, mention ONE technology which can be employed to generate it. [6 Marks]
- (b) Design an electrostatic generator which can generate  $900\mu\text{A}$ . You may assume the belt's velocity to be any value within the range of  $15\text{-}30\text{ms}^{-1}$ . The generator is to be enclosed in an earthed tank filled with Sulphur Hexafluoride ( $\text{SF}_6$ ) which has breakdown strength of  $25\text{MVm}^{-1}$  and relative permittivity of 3.8. [5 Marks]
- (c) In a High Voltage lab, you were tasked to design an impulse generator by using any of the available components of  $1\text{nF}$ ,  $50\text{nF}$ ,  $100\text{nF}$ ,  $30\mu\text{F}$ ,  $360\Omega$ ,  $500\Omega$  and  $1\text{k}\Omega$ . Draw the circuit of your design. Evaluate the expected output of your generator with charging voltage of  $200\text{kV}$ . [14 Marks]

**Question 2**

- (a) Identify and describe THREE types of standard high voltage tests. [6 Marks]
- (b) List down FOUR types of high voltage test on cables. [4 Marks]
- (c) You have applied 20 shots of Up and Down standard lightning impulse test to an insulation of a high voltage cable. Complete Table Q2(c) and calculate the 50% breakdown voltage and the standard deviation. [15 Marks]

**Table Q2(c)**

Voltage (kV)	Test Result																			
50							X													
49																		X		X
48																				
47		X								O					O					
46	O		O																	
45														O						

Continued.....

**Question 3**

- (a) Compare the rate at which solid, liquid and gas recovers its respective strength after suffering from electrical breakdown. [3 Marks]
- (b) Table Q3 shows the experimental measurements obtained while studying the Townsend phenomenon in a gas under a uniform electric field. Note that  $d$  is the gap distance while  $I$  is the measured current at each corresponding gap distance. Compute the values of the Townsend's first and second ionization coefficient. You are required to construct a graph by making use of the data in Table Q3 in order for you to perform the required computation.

**Table Q3**

$d$ (mm)	1	2	3	4	5	6	8	10	12	14	16
$I$ (pA)	17	20	25	31	38	43	75	100	148	265	460

[12 Marks]

- (c) With the help of a graph, illustrate the mechanisms of failure and variation of breakdown strength in solids with time of stressing. Then, briefly explain each mechanism. [10 Marks]

**Question 4**

- (a) Define an insulation coordination. [3 Marks]
- (b) List down FOUR types of insulation. Then, explain each type. [12 Marks]
- (c) Insulation failure may occur due to power frequency voltages or impulse voltages. List down two possible reasons due to each of the aforementioned type of voltages. [4 Marks]
- (d) Outline THREE requirements to be fulfilled to ensure optimum insulation coordination. [6 Marks]

**End of the Paper.**